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CropBooster-P

Deliverable 1.5

Title: Digested outcome and recommendations of the workshop regarding nutritional improvement

Start date of the project: **November 1st, 2018** / Duration: 36 **months**
Planned delivery date: M8 (June 2019)
Actual submission date: 30 June 2019
Work package: WP1 / Task: 1.3

Work package leader: ULANC

Deliverable leader: UCPH

Version: Draft 1

Date of version: March 2019

Dissemination level	Public

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1. Introduction

Nutritional quality remains a major focus area in plant breeding for the continued improvement of agronomic traits and future crop optimization. With the growing demands for increased productivity and limitations in arable land and nutrient availability, the need for nutrient provision and uptake optimization in a sustainable manner gains significance. Obtaining an overview on the current state of nutritional quality crops produced within Europe including methods, technologies and pathways would therefore provide an insight into various aspects of plant improvement and nutrition security, contributing to a toolbox that would prove invaluable to the future directions of crop research.

The WP1-Research toolbox Task 1.3 will comprise of an overview of the current and future focus areas and approaches to improve crop nutritional quality. This will include a survey of published scientific literature for all major aspects of crop nutrition- spanning nutritional quality (ie, macronutrients, micronutrients, specialized metabolites and anti-nutrients) in major, minor, niche and aquatic crop species. Methods to improve nutritional quality, current and future technologies to improve crop nutrition and existing geographical trends with respect to nutrition will be included in this study.

Additionally, within the scope of Task 1.3 is to contribute to crop nutritional quality specific trends in the current agricultural and crop production scenario in conjunction with Task 1.1. This will serve as preparatory material for the stakeholder group meeting. Based on the outcome from this meeting, the four scenarios generated will create potential outcomes that serve as reference points in the construction of the data collection surveys and final report within task 1.3/ 1.5.

2. Objectives

WP1-Research toolbox Task 1.3 aims to map existing and putative future areas, strategies and technologies (including modelling approaches) with the potential to improve nutritional quality in different crop species relevant to selected Geographical regions of Europe (NW,SE, Central-East). The current, updated methods and techniques used to evaluate the nutritional quality of different crops (eg. HPLC, NMR NIR/FTIR) will be logged and the different identified options to improve nutritional quality taking major and underused/underdeveloped terrestrial and aquatic crops and technologies with economic potential and value for Europe will be listed. Trade-offs between nutritional quality and yield will be included.

3. Partners and fields of expertise

Organisation name	Short name	Country	Area(s) of specialization
Københavns Universitet	UCPH	Denmark	• photosynthesis; regulation of photosynthesis, chloroplast biology, thylakoid membrane • plant development, microProteins, tissue culture
Consiglio Nazionale delle Ricerche	CNR	Italy	• Secondary metabolism, evaluation of phenols, antioxidant activities of plant extracts, identification/separation of bioactive compounds by HPTLC, HPLC, NMR • antioxidants and bioactive components in food products, nutraceutical studies using cellular and animal models

Organisation name	Short name	Country	Area(s) of specialization
			• Reduction of antinutritional factors and modulation of bioactive molecules in seeds by genetic, genomic and biotechnological approaches, mineral biofortificaton of seed crops • New breeding technologies for biofortification of tomato and other horticultural crops, nutritional assessments on biofortified crops or underutilised varieties
Europese Organisatie voor Wetenschappelijk Plantenonderzoek	EPSO	Belgium	
Heinrich-Heine-Universitaet Duesseldorf	UDUS	Germany	
Julius Kuehn-Institut Bundesforschungsinstitut fuer Kulturpflanzen	JKI	Germany	• New molecular technologies in agriculture – incl. improvement of food/feed quality • genome editing in different plants
Centre National de la Recherche Scientifique	CNRS	France	• essential metal (Fe, Mn) transport and seed storage, toxic metal uptake in plants • biochemistry, metabolic engineering and functional analysis of plant metabolism
University of Nottingham	UNOTT	UK	• plant and crop physiology, wheat, rice, photosynthesis • crop physiology, agronomy, drought, nutrient use efficiency, nitrogen, wheat
Institut National de la Recherche Agronomique	INRA	France	• quantitative genetics, genetic control of tomato fruit quality (sensory and nutrional), fruit and vegetable quality in general
University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	USAMV CLUJ	Romania	• Biochemistry of plant phytochemicals, Advanced techniques for phytonutrients’ encapsulation, Analysis (Identification/separation) of bioactive compounds from plants and food by LC-MS, FTIR • Food biotechnology, Microencapsulation of probiotics, Molecular gastronomy, Biofortified crops
ARVALIS Institut du vegetal	ARVALIS	France	• crop nutrition (cereals, maize and potato) linked to crop production (quantity-quality), nutrient cycling in the soil and genetics

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4. Meetings and teleconferences

The following meetings and teleconferences have been held to discuss the project status (specific or related to the development of task 1.3):

- **27 Feb 2019 Teleconference- Work package leaders**
  Defined the scope of data assimilation and collection format.
- **7 March 2019 Teleconference- WP1 Task 1.3 partners**
  Discussed format of data collection, level of detail, deliverables and assigned responsibilities according to expertise and areas of interest. Created shared folder for internal data collection. Data collection in progress.
- **3 April 2019 F2F Meeting WP leaders-** Finalize template and data collection model
- **4 April-** Status update call WP 1.1
- **12 April 2019-** teleconference- workshop preparation WP1.1
- **16-17 April 2019**- Scenario planning and building workshop WP1.1
- **26 April-** UCPH internal feedback meeting WP1.3
- **14 May-** Teleconference with WP1 leaders, Database format discussion
- **20 May-** Teleconference with WP1.3 members- update call
- **13 June-** UCPH internal meeting to discuss survey format WP1.3
- **25 June-** CropBooster-P Excom meeting

5a. WP1 Task 1.1 Trend cards:

In preparation for the scenario building workshop, a list of relevant trends and issues focusing on subtask nutrition was collected from among the partners and assimilated into a long list of trends. These were further sorted according to relevance to the CropBooster-P project. A final shortlist of trends was proposed which contained trends pertaining to crop yield, nutrition and sustainability subtasks. These trends were then further processed into trend cards.

Trend cards capture the key aspects pertaining to each trend for consideration by the stakeholder group. These include facts and figures relating to the trend, examples of key stakeholders and influencers, the related sub trends and the relevance for the CropBooster-P project.

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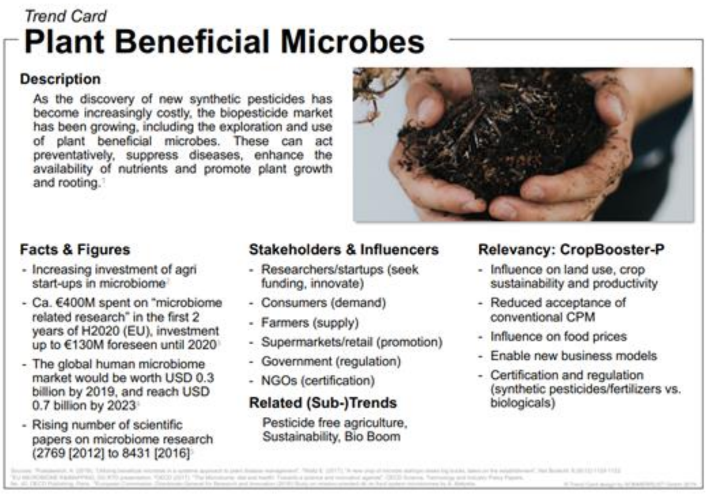
List of trends considered for Scenario Building

Trends (in alphabetical order):

1) Aging Population
2) AI & Big Data
3) Alternative Nutrition Sources
4) Animal Welfare
5) Biofortification
6) Biotech
7) Blockchain
8) Cheaper Food
9) Circular Bioeconomy
10) Climate Change
11) Cultivar / Species Mixtures
12) Decline of Pollinators & Biodiversity
13) Declining Chemistry for Pest Control
14) Diet-related Chronic Diseases
15) Do-it-Yourself
16) E-Commerce
17) Economic Pressure on Farms
18) Electrification
19) Environmental Concerns
20) Fair Trade
21) Globalization
22) Healthy Lifestyle
23) ICT on the Rise
24) Increased Mechanisation
25) Intellectual Property
26) Land-Use Pressure
27) NBTs & Genetic Modification
28) Offering of Meat Alternatives
29) Organic Farming
30) Plant Beneficial Microbes
31) Population Growth
32) Power of the Online Public
33) Product & Research Regulation
34) Public Engagement in Research
35) Reduction of / Altered Genetic Resources Circulation
36) Renewable Energy
37) Resource Scarcity
38) Rising Disposable Income
39) Risk Sensitivity
40) Robotics
41) Self-Tracking / Quantified Self
42) Sustainability
43) Transparency
44) Urban Farming / Greenhouses
45) Urbanization



Trend Card

Plant Beneficial Microbes

Description

As the discovery of new synthetic pesticides has become increasingly costly, the biopesticide market has been growing, including the exploration and use of plant beneficial microbes. These can act preventatively, suppress diseases, enhance the availability of nutrients and promote plant growth and rooting.[1]

Facts & Figures

- Increasing investment of agri start-ups in microbiome[2]
- Ca. €400M spent on "microbiome related research" in the first 2 years of H2020 (EU), investment up to €130M foreseen until 2020[3]
- The global human microbiome market would be worth USD 0.3 billion by 2019, and reach USD 0.7 billion by 2023[4]
- Rising number of scientific papers on microbiome research (2769 [2012] to 8431 [2016])[5]

Stakeholders & Influencers

- Researchers/startups (seek funding, innovate)
- Consumers (demand)
- Farmers (supply)
- Supermarkets/retail (promotion)
- Government (regulation)
- NGOs (certification)

Related (Sub-)Trends

Pesticide free agriculture, Sustainability, Bio Boom

Relevancy: CropBooster-P

- Influence on land use, crop sustainability and productivity
- Reduced acceptance of conventional CPM
- Influence on food prices
- Enable new business models
- Certification and regulation (synthetic pesticides/fertilizers vs. biologicals)

Fig.1 Final list of list of trends to be considered at the scenario building workshop in alphabetical order (above) and Example of a trend card for the scenario building workshop (below). Trends span aspects relating to crop yield, nutrition, and sustainability.

Based on the trend card information and proxy variables raising questions regarding crop production in the future, themes were identified based on which the following scenarios were developed:

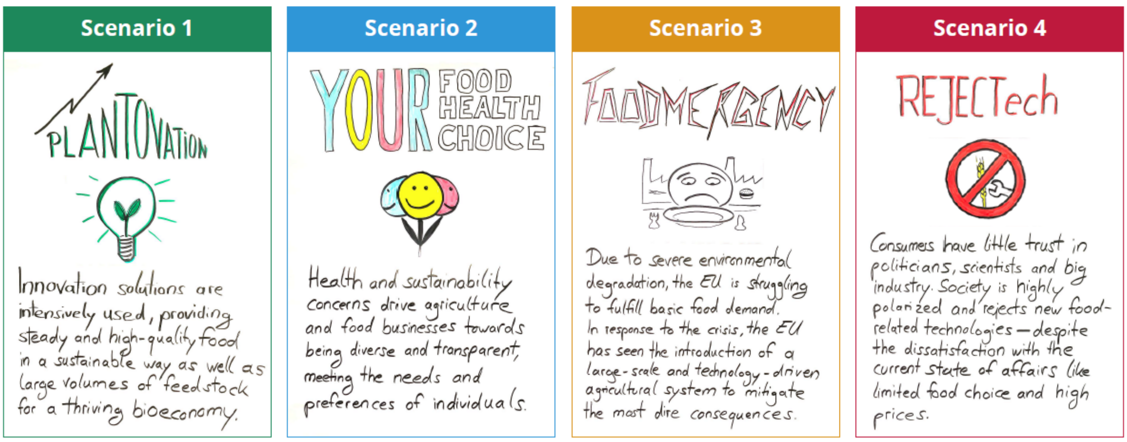


Fig.2 Overview of the four scenarios covering a wide range of outcomes. These scenarios will serve as a template for specific questions in the development of surveys within tasks 1.2-1.4.

Based on the scenarios developed, specific aspects within the surveys will be included in order to generate outcomes specific to Nutritional quality within each of these learning scenarios. Some of the emphasised aspects of the survey are:

Scenario 1- Plantovation
Fibres, high value crops
High value compounds/phytochemicals
Supercrops pushing limits of yield/area

Scenario 2- Your food, your health, your choice
High value compounds, superfoods
Alternative plant protein sources
GM alternatives

Scenario 3- Foodmergency
Calories are most important- Focus sugars and fats
Short growing time, robust crops
Soil quality/ nutrient availability concerns

Scenario 4- Rejectech
Alternative crops/ ancestral cultivation/landraces
Alternative nutrition sources to meet lack of biomass/yield

5b. WP1 Task 1.3 outcome:

Revised Phases:

WP1 Task 1.3 has been divided into 3 smaller phases to facilitate data collection:

1) Definition of template, division of tasks among partners according to expertise and areas of interest (by M5 end)
2) Data collection/ filling templates (by M11 middle)
3) Compilation and filling in the gaps in the collected data, arranging the collected information in a comprehensive format and upload to a central location (as part of T1.5 by M12 end)

Feedback from the partners at the scenario building workshop:

A framework within which data collection of task 1.3 was proposed to the participants of the workshop for feedback:

Within the scope of task: (what data collected will account for)
Documentation of traits, processes and pathways pertinent to crop nutrition. This includes:

- Current trends/ state of crop nutrition within Europe
- Methods to improve and optimize nutritional yield/ content in crops
- Nutrient availability (to the crops)
- Breeding technologies relevant to nutrient use efficiency, uptake and metabolism
- Transferable technologies (value capture)
- Synthetic biology to enhance nutrition
- Documentation of current state of nutrient categories per crop type: Carbohydrate, protein, fats, vitamins and minerals
- Aquatic crops

- Niche/ underdeveloped/ potentially beneficial crops
- Food and fodder crops
- Specialized metabolites with nutritive scope
- Toxic compounds/ anti-nutrients
- Document pathways, genes involved and orthologues
- Tradeoffs between nutrition and yield and nutrition and sustainability (to contribute to WP1.5 eventually)
- Spatial distribution of nutrients/ partitioning
- Nutrient uptake/ availability changes based on Geographical location within Europe

Outside the scope of this task: (what data collected will not account for)

- Nutrient trends outside Europe/ non-European crops
- Non-measurable traits/ traits without genetic basis
- Social/ethical/environmental/physical factors (eg. GMO debate, global warming, weather inclemency and pests)
- Projections- predicting nutrient trends for future. (Capture current state of the art)
- Organoleptic quality (taste, smell…)

Based on this input, the partners suggested the following improvements to the data collection strategy:

Toolbox format

- Favor a searchable database as an output, which can be updated as new information/ technologies arise
- Compiling the toolbox into an encyclopedia format was suggested to be unnecessary (as this could go out of date)

Outcome: Toolbox will comprise shorter report outlining tradeoffs, as well as a searchable spreadsheet containing the main information for each gene/trait analyzed. The spreadsheet will be generated from smaller surveys, each survey contributing to a line of text/ data in the final spreadsheet.

Priority crops

- The suggested list of priority crops which will be considered in the database should include vegetable and fruit examples
- Niche crops could be considered in a separate category distinct from priority crops, to ensure important information is preserved

Outcome: Data collection survey will include option to add examples (free text) for crops that are not predefined, to allow for additional input.

Traits

- Consider bio-digestability and availability of protein as a trait
- Consider specialized traits for specific nutritional requirements, for example, gluten-free wheat
- Dealing with nutritional tradeoffs (for example, starch/protein partitioning within a crop)

Outcome: Space will be made available in the data collection surveys to add specific traits, as all cannot be foreseen/ impact assessed. Specialized traits such as engineering crops to specific dietary requirements and nutritional tradeoffs are out of the main scope of the current exercise. However, provision will be made within the database to mark traits of specific interest for which there is a genetic basis.

Technologies

- Post-harvest technologies to ensure optimal nutrient quality during crop storage
- Stress induced transposable element mobilization

Outcome: Post-harvest technologies are out of the defined scope of CropBooster-P and hence will not be included. Space will be made available in the surveys to add technologies.

Revised template for data collection:

Based on the input from the Stakeholders, and results from the WP 1.1 scenario building exercise, a revised plan for data collection was formulated. WP1.2- 1.4 will collect Data in the form of a common survey, with two sections:

- **Section 1, common to WP 1.2-1.4**

Column	Column 'choices'
Scale (by climate)	**Mediterranean**, humid subtropical, marine, humid **continental**, **subarctic**, **tundra** and **highland, other**
If other, specify	
Relevance to cropbooster..	Free text
Species group type	**Algae** **Forage grasses** **Grain staples** **N2 fixers** **Oilseed** **Vegetables** **Fibres and lignocellulose** **Root staples** **Model Plants** **Other**
If other, specify	
Species	Fucus, **Laminaria, Porphyra, Ulva** **Ryegrass, Alfafa,** Clover, Sugarcane, Miscanthus **Wheat,** Barley, Rice, **Maize**, Sorghum, Rye, Oats, Durum wheat, Millet, Field bean, **Soybean,** Lupin, **Pea,** Clover **Sunflower**, Soybean, **Rapeseed**, olive, maize **Tomato**, leafy vegetables (spinach), **Lettuce**, Brassicas, Pea, Carrots, Parsnip, Grapes, Hemp, **Poplar,** Willow, **Miscanthus,** Switchgrass, Douglas Sitka, Eucalyptus, Spruce, **Potato, Sugarbeet**, Onion **Arabidopsis, Tobacco,** Rice, Spinach, Maize **Grape, Pome,** Citrus,

Fig.3 Extract from the construction of columns for common data collection. Current updated version: See Annexe 1

This section consists of preliminary information common between subtasks 1.2-1.4- These columns for data collection will be used as the basis for a clickable survey. Based on the choices made in this section, survey participant will be redirected to the specific subtask the entry is related to in the following section. The data entered in the common fields serve as a platform to integrate the final excel file generated, as well as identify and link commonalities between subtasks.

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- **Section 2, specific to WP1.3, Nutritional quality**

The topics in section 2 were assigned to the partners within the subtask 1.3, within their areas of expertise.

L1	L2 (CLASS)	L3 (TYPES OF NUTRIENT)	L4 (Categories within nutrient type)	L5 (factors affecting nutritional quality)
nutritional quality	**Protein**	**Amino acids**	**isoleucine** **leucine** **lysine** **methionine** **phenylalanine** **threonine** **valine** **Argenine** **tryptophan** **enzymes** **Gliadines/Glutenines** Other	**Sulfur deficiency** **Nitrogen deficiency** **Digestibility** **Stress: other** **Heat stress** **Drought stress** **Fermentation properties**
nutritional quality	Carbohydrate	Sugars	Monosaccharides Disaccharide Polyols	Stress: UV radiation Stress: light intensity and photoperiod Stress: Water high or low

Fig.3 Extract from the construction of levels specific within the subtask 1.3- Nutritional quality. Current updated version: See Annexe 2

This section consists of 5 levels specific to task 1.3- Level 1 selects the megatrait (yield, nutritional quality or sustainability) Level 2 identifies nutrient class, Level 3 and 4 lists categories and sub categories within each nutrient type. Level 5 identifies the factors which influence the nutritional quality. The aim of this data collection strategy is to precisely identify the role of each trait selected within a specific context of plant nutrition, which will serve as the basis for the report in task 1.5.

Construction of a survey

Based on the input from the common columns and the levels specific within each subtask, a data collection survey is being designed.

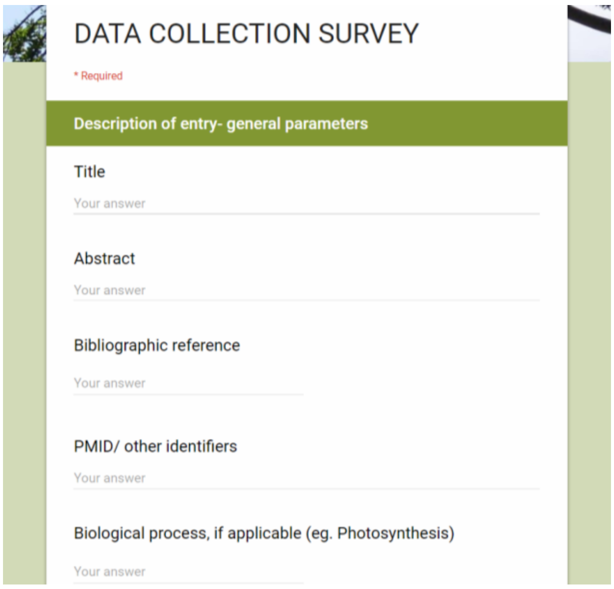

Fig.4 Extract from the current version of the data collection survey.

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The survey is currently being developed, with input from all affiliated partners. A final version of the survey ready for data collection for subtask 1.3 is expected to be launched by the second week of July, 2019.

6.Deliverables

The following WP1 1 Task 1.3- specific deliverables are planned:

Number	Deliverable Title	Lead beneficiary	Type	Dissemination level	Delivery month
D 1.4	Preparatory documents ready for discussions during workshop with (core) SHG on nutritional improvement	UCPH	Report	Public	5
D1.5	Digested outcome and recommendations of the workshop regarding nutritional improvement	UCPH	Report	Public	8

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7. Annexes

Annexe 1

Column	Column information	Column 'choices'
Scale (by climate)		**Mediterranean**, humid subtropical, marine, humid **continental**, **subarctic**, **tundra** and **highland, other**
If other, specify		
Relevance to cropbooster..	Eg. Increased canopy cover, increases biomass	Free text
Species group type	Eg. Algae, forage grasses	**Algae** **Forage grasses** **Grain staples** **N2 fixers** **Oilseed** **Vegetables** **Fibres and lignocellulose** **Root staples** **Model Plants** **Other**
If other, specify		
Species	(can this be spit per species group type?)	Fucus, **Laminaria, Porphyra, Ulva** **Ryegrass, Alfafa,** Clover, Sugarcane, Miscanthus **Wheat,** Barley, Rice, **Maize**, Sorghum, Rye, Oats, Durum wheat, Millet, Field bean, **Soybean,** Lupin, **Pea,** Clover **Sunflower**, Soybean, **Rapeseed**, olive, maize **Tomato**, leafy vegetables (spinach), **Lettuce**, Brassicas, Pea, Carrots, Parsnip, Grapes, Hemp, **Poplar,** Willow, **Miscanthus,** Switchgrass, Douglas Sitka, Eucalyptus, Spruce, **Potato,** **Sugarbeet**, Onion **Arabidopsis, Tobacco,** Rice, Spinach, Maize **Grape, Pome,** Citrus, Olive, Strawberry, Raspberry, other
If other, specify		
Method summary*	Technologies employed to achieve y/n/s effect	Conventional Breeding Populations/Mapping, Magic, Diversity Sets Genome Availble MAS GWAS Mutant Populations Tagged populations Mutagenesis Epimutation TILLING Transposon Mobilisation Metabolic design Conventional GMO

		Gene Editing Plastid transformation Synthetic Biology Modelling Phenotyping Speed Breeding other
If other, specify		
Yield benefit**		Yes/ no
Yield benefit- how**		Free text
Nutrition benefit**		Yes/no
Nutrition benefit-how**		Free text
Sustainability benefit**		Yes/no
Sustainability benefit -how**		Free text
Biological process	Eg. respiration	TBD
Genetic pathway (if applicable)		Free text
Genes involved		Free text
Orthologues?		Yes/no
Orthologues in which crops		Free text
Bibliographic reference(s)		Free text
title		Free text
abstract		Free text
uniprot		Free text
PMID		Free text
Transferability potential		Yes/ no
Comments on transferability		Free text
What technology would make this example transferable?	CRISPR, GMO	Free text
General comments		

*This would help build into the technical annexe

**This will determine correlations and tradeoffs for WP 1.5

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Annexe 2

L1	**L2 (CLASS)**	**L3 (TYPES OF NUTRIENT)**	**L4 (Categories within nutrient type)**	**L5 (factors affecting nutritional quality)**
nutritional quality	**Protein**	**Amino acids**	**isoleucine leucine lysine methionine phenylalanine threonine valine Argenine tryptophan enzymes Gliadines/Glutenines**	**Sulfur deficiency Nitrogen deficiency Digestibility Stress: other Heat stress Drought stress Fermentation properties**
			Other	
nutritional quality	Carbohydrate	Sugars	Monosaccharides Disaccharide Polyols	Stress: UV radiation Stress: light intensity and photoperiod Stress: Water high or low Stress: heat Stress: high nitrogen
		Oligosaccharides		

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		Polysaccharides	Starch Non Starch	Genetic variation Genes affecting biosynthesis/regulation/transport/ Metabolism Biomass allocation Sulfur deficiency Nitrogen deficiency Digestibility Fermentation properties Stress- other
			Other	
nutritional quality	Oil and fats	sterols saturated fatty acids- lauric		Structural characteristics Stability- heat Structural characteristics Stability- light Structural characteristics Stability- humidity Molecular characteristics Antioxidant capacity Accumulation- storage root Accumulation- seed Accumulation- shoot system Accumulation- root system
		saturated fatty acids-	myristic palmitic stearic oleic	
		unsaturated fatty acid-	linoleic α linoleic	
		long chain polyunsaturated fatty acids monohydroxy fatty acid derivatives		
			Other	
nutritional quality	Specialized metabolites (secondary metabolites with nutritive role)	Secondary metabolites-	Organic acids Bioactive compounds phenolics, terpenoids glucosinolates	Stress: UV radiation Stress: light intensity and photoperiod Stress: flood Stress: drought Stress: heavy metal Stress: high nitrogen Biostimulants Microbes in rhizosphere intra/inter-species variation Genes affecting biosynthesis/regulation
		Low molecular weight antioxidant:	glutathione ascorbate	

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			Other	
nutritional quality	Minerals	Macronutrient	Nitrogen Phosphorous potassium Calcium Sulfur Magnesium Carbon Oxygen Macronutrient-Hydrogen	Stress- heat Stress-cold Stress- high humidity Stress- flood Stress- drought Stress-salinity Stress-toxicity Stress-other Stress- nutrient overload Stress- Nutrient deficiency Stress- soil toxins Stress- soil composition Stress- pH Fertilizer- form Fertilizer-quality Biostimulants Geographical factors Bioavailability Microbes- in rhizosphere Microbes-fertilizer use efficiency- nitrogen fixation Sulphur nutrition Pathogen toxins Intra species cultivar- specific variation Uptake and allocation to edible organs Membrane transporters Efflux proteins Organic molecule synthesis Stress- transposable elements
		Micronutrient	Iron Calcium Magnesium Chloride Potassium Sulphur Manganese Zinc Iodine Selenium	
			Other	
nutritional quality	Vitamins	Vitamin A	α-Carotene β-Carotene β-Cryptoxanthin	Antioxidant potential Enzymatic cofactor Redox chemistry

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		Vitamin B	Thiamine Riboflavin Niacin Pantothenic acid Pyridoxal Biotin Folates Cobalamin	Enzyme protection Enzyme precursor Biosynthesis of enzymes Root uptake Membrane transporters Nitrogen fertilizers Oxidative stress Component of biological pathway Application of polyamines Stress-temperature Stress-other Pathogen toxins Bioavailability digestability
		Vitamin C	Ascorbate	
		Vitamin E	Tocopherols Tocotrienols	
		Vitamin K	Phylloquinone	
			Other	
nutritional quality	Anti-nutrients	Proteinaceous antinutrients Non proteinaceous antinutrients	Protease inhibitors Amylase inhibitors Lipase inhibitors Lectins Ribosome Inactivating Proteins Phytate Oxalates Phenolics (tannins, gossypol, other phenolics) Glucosinolates Dietary fibre	intra-species variation inter-species variation Genes affecting biosynthesis Genes affecting regulation Exogenous factors affecting synthesis and stability Genes affecting biosynthesis/regulation Genes affecting transport/metabolism Transport/competition with mineral nutrients Enzyme inhibitors
			Other	

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	Toxic compounds	Toxic compounds- elements Toxic compounds- metabolites	Nitrate Heavy metals- Arsenic Heavy metals-Lead Heavy metals- Cadmium Cyanogenic glycosides Saponins Alkaloids Coumarins	intra-species variation inter-species variation Genes affecting biosynthesis Genes affecting regulation Exogenous factors affecting synthesis and stability Genes affecting biosynthesis/regulation Genes affecting transport/metabolism Transport/competition with mineral nutrients Enzyme inhibitors
			other	
nutritional quality	Fibre/ feedstock		Ethanol content Digestibility Lignin content Lipid content Fatty acid content Fatty acid composition Alkyl ester content Butanol content Nutrient use efficiency (s) Water use efficiency (s) Acid detergent fibre Neutral detergent fibre Total dietary fiber	Soluble/insoluble ratio Polymeric structure Protein content
			Other	